

7150plus DIGITAL MULTIMETER



OPERATING MANUAL

Specification

Accuracy

The following applies to the Accuracy sections.

Limits of error:

Applicable after 2 hours warm up. DC and resistance measurement with null in use. The accuracy specification gives the uncertainty in measurement for the stated time and temperature range and is expressed in two parts – as a fraction of the reading, (in percentage), plus a number of counts in the least significant digit displayed. Drift will significantly reduce with increasing age of the instrument.

Temperature coefficient

Expressed as \pm [% reading + counts] / $^{\circ}$ C. Valid from 0 to 40 $^{\circ}$ C. Temperature coefficient need only be applied outside the temperature span quoted with T_e .

Calibration temperature

Calibration Temperature (T_e) is the temperature of the calibration room environment. Calibration occurs at 20 $^{\circ}$ C (23 $^{\circ}$ C for USA) and is directly traceable to International Standards via the National Physical Laboratory or the National Bureau of Standards. Recalibration is valid at T_e from 15 $^{\circ}$ C to 30 $^{\circ}$ C. A 3 hour warm up time is recommended before attempting recalibration.

DC Voltage

Accuracy: \pm [% rdg + counts], 5½ digits.

Nominal Range	Sensitivity 6½D	Sensitivity 5½D	Input Resistance	Stability $T_e \pm 1^{\circ}\text{C}$ 24 hrs	Limits of Error	
					$T_e \pm 5^{\circ}\text{C}$	1 Year
0.2V	100nV*	1µV	>10GΩ	0.002 + 3	0.006 + 4	0.008 + 4
2.0V	1µV	10µV	>10GΩ	0.002 + 3	0.005 + 4	0.006 + 4
20V	10µV	100µV	10MΩ	0.002 + 3	0.006 + 4	0.008 + 4
200V	100µV	1mV	10MΩ	0.002 + 3	0.006 + 4	0.008 + 4
1000V	1mV	10mV	10MΩ	0.002 + 3	0.006 + 4	0.008 + 4

For 6½ digits add 3 to counts error + 1µV.

3½ digit accuracy add 1 to counts error. 4½ digit accuracy divide counts error by 2.

*Over the bus only.

Readings per Second

Digits	Full Scale	Integration	Track rdg/s
3½	2300	6.67ms	25
4½	23000	40ms	13
4½	23000	50ms	12
4½	23000	100ms	7
5½	230000	400ms	1
6½	2300000	6.4s	1

Linearity: <0.001% of range

Input current: <150pA

Range of null: > \pm 1mV

Temperature coefficient: <0.001% rdg/ $^{\circ}$ C + 0.2 µV/ $^{\circ}$ C

Overload protection:

Autorange: 1.2kV peak

Fixed ranges: 0.2, 2V 750V rms

20, 200, 1000V 1.2kV peak

Resistance

Accuracy: \pm [% rdg + counts], 5½ digits.

Nominal Range	Sensitivity 6½D	Sensitivity 5½D	Measuring Current	Stability $T_e \pm 1^{\circ}\text{C}$ 24 hrs	Limits of Error	
					$T_e \pm 5^{\circ}\text{C}$	1 Year
2.0kΩ	1mΩ	10mΩ	100µA	0.002+4	0.015+5	0.02+5
20kΩ	10mΩ	100mΩ	100µA	0.002+3	0.015+4	0.02+4
200kΩ	100mΩ	1 Ω	10µA	0.003+3	0.025+4	0.03+4
2.0MΩ	1Ω	10 Ω	1µA	0.005+3	0.025+4	0.03+4
20MΩ	10Ω	100 Ω	100nA	0.03 +20	0.045+20	0.05+20

For 6½ digits: add 3 to counts error + 5mΩ. 3½ digit accuracy add 1 to counts error.

4½ digit accuracy divide counts error by 2.

Measurement configuration:

4-wire, or 2-wire auto-sense.

Linearity: <0.001% of range

Maximum overload protection: 350V peak, 250V rms

Readings per second

As for dc voltage.

Maximum open terminal voltage: <7V

Range of null: > \pm 10Ω

Temperature

coefficient: <0.004% rdg/ $^{\circ}$ C + 2mΩ/ $^{\circ}$ C
20MΩ range <0.006% rdg/ $^{\circ}$ C

Temperature

Using 100Ω Platinum Resistance Thermometer linearised to IEC751.

Temperature range:

-200 $^{\circ}$ C to +600 $^{\circ}$ C

Max Resolution: 0.01 $^{\circ}$ C or °F

Conformance to IEC751: 0.1 $^{\circ}$ C

Measurement current: 100µA

Resistance at 0 $^{\circ}$ C: 100 ohms

Specification

AC Voltage True rms of ac component.

Accuracy: $\pm [\% \text{ rdg} + \text{counts}]^*$. 5½ digits. For inputs above 10% of range.

Stability: 24 hours, $T_e \pm 1^\circ\text{C}$

Range	40Hz-10kHz	10kHz-30kHz	30kHz-50kHz	50kHz-100kHz
0.2V	0.03 + 15	0.05 + 40	0.25 + 80	0.4 + 200
2.0V	0.03 + 15	0.05 + 40	0.25 + 80	0.4 + 200
20V	0.04 + 15	0.05 + 40	0.25 + 80	0.4 + 200
200V	0.04 + 15	0.05 + 40	0.25 + 80	0.4 + 200
1000V	0.05 + 15	0.06 + 40	0.25 + 80	0.4 + 200

Limits of error:

90 Day, $T_e \pm 5^\circ\text{C}$

Range	40Hz-10kHz	10kHz-30kHz	30kHz-50kHz	50kHz-100kHz
0.2V	0.07 + 15	0.08 + 40	0.3 + 80	0.45 + 200
2.0V	0.06 + 15	0.08 + 40	0.3 + 80	0.45 + 200
20V	0.07 + 15	0.08 + 40	0.3 + 80	0.45 + 200
200V	0.07 + 15	0.08 + 40	0.3 + 80	0.45 + 200
1000V	0.08 + 15	0.09 + 40	0.3 + 80	0.45 + 200

1 Year, $T_e \pm 5^\circ\text{C}$

Range	40Hz-10kHz	10kHz-30kHz	30kHz-50kHz	50kHz-100kHz
0.2V	0.08 + 15	0.09 + 40	0.35 + 80	0.5 + 200
2.0V	0.07 + 15	0.09 + 40	0.35 + 80	0.5 + 200
20V	0.08 + 15	0.09 + 40	0.35 + 80	0.5 + 200
200V	0.08 + 15	0.09 + 40	0.35 + 80	0.5 + 200
1000V	0.09 + 15	0.1 + 40	0.35 + 80	0.5 + 200

Extended frequency error: 1 year, $T_e \pm 5^\circ\text{C}$ Low frequency

$\pm [\% \text{ rdg} + \text{counts}]$	
3-5Hz	10.0 + 100†
5-10Hz	8.0 + 100†
10-20Hz	0.95 + 100
20-40Hz	0.3 + 40

High frequency

$\pm [\% \text{ rdg} + \text{counts}]$	
100-200kHz	5 + 400†
(0.2V to 200V)	
200-500kHz	10 + 1000†
(0.2V to 20V)	
500kHz-1MHz	15 + 1500†
(2V only)	

* For 3½ and 4½ digits divide counts figure by 10.
Double counts figure for 1% to 10% of range.
† Typical figures.

Temperature coefficient: $<0.008 \text{ rdg}/^\circ\text{C}$ up to 20kHz

Input impedance: $1\text{M}\Omega, 100\text{pf}$

Crest factor: 10:1 add 1% of rdg

Peak input: < 5 times full scale or 1.2 kV

Sensitivity: Full scale (230000) 5½ digits:
 $1\mu\text{V}$ on 0.2 range

Decreases by a factor of 10 for each successive range to 1000V.

Readings per second: As for dc voltage except 5½ digit rdg is 0.8/second

Maximum ratings

Autorange: $<1\text{kHz}$ 750V rms or 1.2kV peak
 $>1\text{kHz}$ 200V rms

Fixed range: 0.2, 2V $<1\text{kHz}$ 500V rms

$>1\text{kHz}$ 120V rms

20, 200, 1000V $<30\text{kHz}$ 750V rms or 1.2kV peak

$>30\text{kHz}$ $2 \times 10^7 \text{ V/Hz}$

DC content: 400V max

DC Current

Accuracy: $\pm [\% \text{ rdg} + \text{counts}]$, 5½ digits.

Nominal Range	Sensitivity 6½D	Sensitivity 5½D	Stability 24hrs, $T_e \pm 1^\circ\text{C}$	Limits of Error 1yr, $T_e \pm 5^\circ\text{C}$
2000mA	1µA	10µA	0.02 + 5	0.04 + 5

For 6½ digits add 10 to counts error.
3½ and 4½ digits as above.

Full scale:	2300.000mA
Shunt resistor:	100 milliohm
Temperature coefficient:	<0.005% rdg/°C
Burden:	<0.8V
Overload protection:	2A fuse
Range of null:	>±1mA
Readings per Second:	As dc voltage

AC Current True rms of ac component

Accuracy: $\pm [\% \text{ rdg} + \text{counts}]$, 5½ digits, 40Hz to 10kHz. For inputs above 1% of range.

Nominal Range	Input Sensitivity	Stability 24hrs, $T_e \pm 1^\circ\text{C}$	Limits of Error 1yr, $T_e \pm 5^\circ\text{C}$
2000mA	10µA	0.05 + 50	0.2 + 50

For 3½ and 4½ digits: divide count error by 10. Above 1kHz add 0.1% rdg.

Full scale:	2300.00mA
Readings per second:	As ac voltage
Temperature coefficient:	<0.01% rdg/°C
Burden:	<0.8V
Overload protection:	2A fuse

Interference Rejection

Normal mode rejection ratio

DC measurements, 6½ to 4½ digits

Power Frequency 50/60/400Hz ± 0.1% $>60\text{dB}$

Effective common mode rejection ratio

With 100Ω imbalance in either lead

DC measurement, 6½ to 4½ digits

Rejection of 50/60Hz: $>140\text{dB}$
400Hz: $>120\text{dB}$
dc: $>150\text{dB}$

AC measurement, 5½ to 4½ digits

Rejection of 50/60Hz: $>60\text{dB}$
dc: $>150\text{dB}$

Maximum Common Mode Voltage:

500V. dc or peak

Specification

Systems Use

Interface, provided as standard IEEE488 (1978)

Provides full talker/listener,talk only and listen only facilities and remote control of all functions. Serial and parallel poll.

Subset: SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, DC1, C0, DT1, E1, and parallel poll.

Additional inputs and outputs:

External trigger input: TTL level or contact closure

Sample complete output: TTL pulse – active low

Display hold: Contact closure

General Data

Power Supply

Voltage:

Switch selected 100/120/220/240Vac
92 to 127V or 188 to 265V

Frequency: nominal 50/60/400Hz

Consumption: <25VA

Protection

Power Supply: fused line and neutral

Current Measurement: fused 2A

Voltage Measurement: spark gap at 1.4kV

Safety

Designed in accordance with IEC348, BS4743, and UL 1244.

Environment

Design & construction to Def Std. 66-31

Issue 1 Cat 111 and MIL-T-28800 Type III

Class 5 Style E.

Operating Temperature:

-5° to 55°C, RH < 30%
0° to 40°C, RH < 93%*

Storage Temperature: -40°C to +70°C

Allow a suitable recovery, warm-up and thermal stabilization period after storage or high humidity conditions.

*90% RH for 2MΩ and 20MΩ

Dimensions

Height:	88mm (3.46ins)
Width:	228mm (8.98ins)
Depth:	278mm (10.94ins)
Weight:	3kg (6.6lbs)

Current shunt, 10A (70457X)

Extends the current measuring capacity to 10A.. Simple plug-in unit.

Shunt Value:	1mV/A (1mΩ)
Accuracy:	± 0.9% fs
Range:	1 to 10A
Temperature Coefficient:	± 250ppm/°C
Maximum Voltage Burden:	100mV at 10A
Absolute Max. Current:	12A

Optional Accessories

Temperature Probes:

Four Terminal 100Ω platinum resistance sensor to I.E.C. 751.

Insertion probe: (71517A)

Temperature range: -50 to 250°C
Error (Class A): < 0.7°C

Surface probe: (71517B)

Temperature range: -50 to 200°C
Error (Class B): < 1.5°C

Radio Frequency Probe (70457F)

Peak-sensing, the probe provides 1v dc output for 1v rms sine wave input when terminated into 10 MΩ. Complete with fittings and adaptors.

Limits of Error: 1V rms sine wave
100kHz to 500MHz: ± 1dB
100kHz to 750MHz: ± 3dB

Voltage Range: 100mV to 40V

DC Isolation: 200V

Working Temperature: -5 to +55°C

Lead Length: 1m

High Voltage Probe (70457E)

Extends measurement of dc voltage to 40kV. Complete with fittings and adaptors. Input resistance 1000 MΩ, when terminated into 10 MΩ.

Voltage Range: 1kV to 40kV

Division Ratio at 20kV, 23°C:
(1000:1) ± 0.5%

Limits of Error 1kV to 40kV, 23°C: ± 3%

Temperature Coefficient: <200ppm/°C

Working Temperature: -5 to +55°C

Lead Length: 1.8m

2.4 REAR PANEL MEASUREMENT CONTROL

With the 7150plus, the user is able to initiate measurements using his own external hardware. Access to the DMM's switching circuits is via 5-way Din socket SK505 which is located on the rear panel (Fig. 2.2).

The socket, which also has an output facility, uses standard TTL logic levels to activate the various control functions.

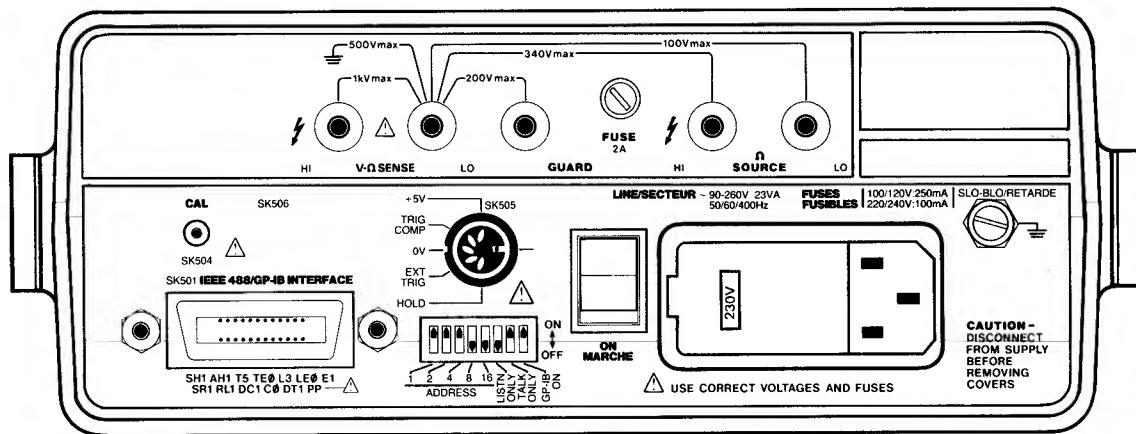


Fig. 2.2 DMM Rear Panel

The following input signals are available via SK505:

Hold

External Trigger

Following an External Trigger command, the following output is available via SK505:

Trigger Complete.

2.4.1 Hold

Usually, the DMM measures continuously. When the HOLD input (normally 'high') is connected to 0V, the Multimeter stops measuring, the *HOLD* annunciator appears and the most recent reading remains in the display.

2.4.2 External Trigger

External Trigger, which is only operative in HOLD, is used to command a single measurement. This input is normally held 'high'. To activate the measurement, the 'EXT TRIG' input must be connected to 0V. To make further measurements, the input must be returned to +5V and the above action repeated.

2.4.3 Trigger Complete

The DMM can indicate (to an external device) that a measurement has been completed. The indication is via the (normally high) 'TRIG COMP' pin which is pulled low (logic 0) for 10-20ms after a measurement has been completed.